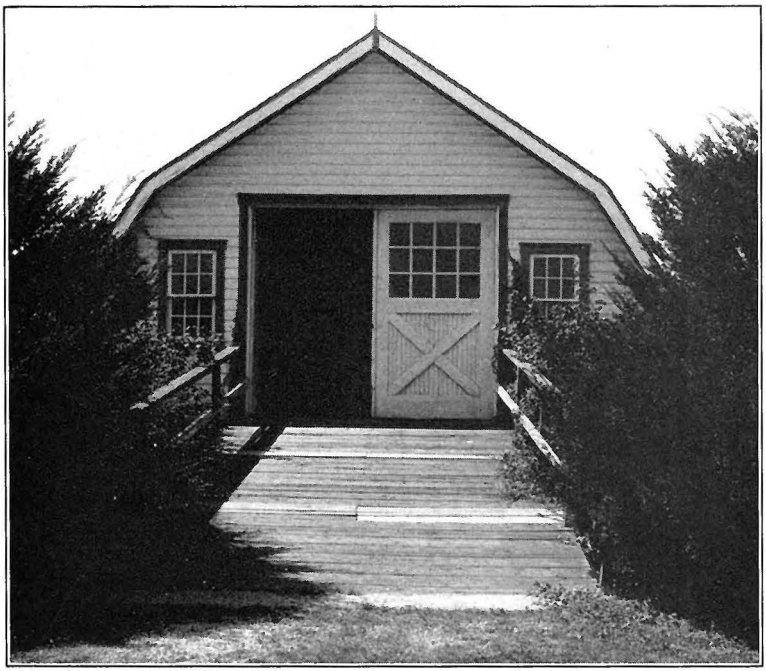
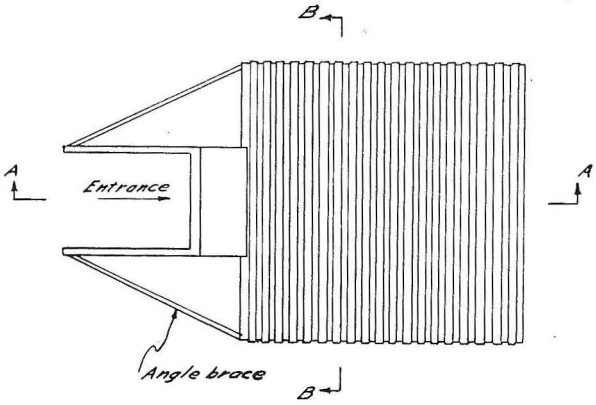
SPECIAL CIRCULAR 72 APRIL, 1946

Farm and Home
UNDERGROUND STORAGES
Made of Steel

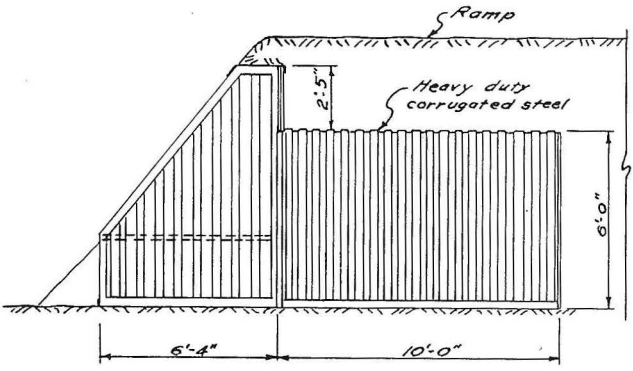


Ramp approach to a building, convenient location
for an underground storage

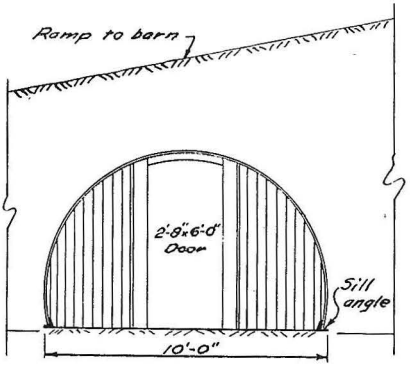
OHIO AGRICULTURAL EXPERIMENT STATION
Wooster, Ohio



PLAN



SECTION A-A



SECTION B-B

Fig. 1.—Plan and arrangement of an all-steel underground storage.

FARM AND HOME UNDERGROUND STORAGES MADE OF STEEL

DONALD COMIN AND WILLIAM JUNNILA[1]

In an earlier publication[2], one of the authors proposed the approach to a barn as a suitable place to construct an underground vegetable and fruit storage and described fully the construction of such a storage of monolithic concrete at the Experiment Station. The reader is referred to the earlier publication for a discussion of the usefulness and advantages of such underground storages on farms, small estates, or for the town dweller who wishes to store a winter's supply of food outside of the house basement.

A recent development, an outcome of the war, has been the production of thousands of prefabricated, all-metal huts, shelters, magazines, and all shapes and sizes of buildings using corrugated steel sheets of tremendous strength and long life. The manufacture of a small corrugated half-round shelter used during air raids has suggested to the authors the possibility of using the same, or similar construction, as a prefabricated, packaged unit which could be shipped knocked down and easily assembled. The aid of a local steel fabricating firm[3] was solicited and it developed a small, inexpensive, all-metal, corrugated structure which is shown in the accompanying photographs and drawings.

The storage is fabricated out of sheet steel in small sections which permit packaging, shipping, and easy erection on the site selected. Erection is simplified by a novel method of clipping the sections together which eliminates the need for bolts and nuts in the arch. By the use of overlapped edges of the sections, water will not readily enter the structure at the seams and joints.

In order to eliminate the necessity of providing a concrete or cement block foundation for the storage, four lengths of 8-inch channel iron for the four sides or walls are provided which serve as a base for the corrugated sheets as they are assembled. These various features, and the steps in assembly, may be seen in the accompanying photographs and drawings.

To give the steel extra long life when in contact with the ground, each piece receives a special coat of paint, oven-baked for a tight bond to the metal. Since the sole insulation used is earth, it is necessary to provide a parapet front and retaining sidewalls

[1]Assistant Horticulturist and Agricultural Engineer, respectively.

[2]Comin, Donald. 1931. A practical underground storage. Ohio Agr. Exp. Sta. Bimo. Bull. 153. Nov.-Dec. 1931, pp. 215-223.

[3]United Steel Fabricators, Inc., Wooster, Ohio.

for the door entrance. A minimum of 2 feet of earth around, and on top of the storage provides protection against freezing temperatures within, especially when a bluegrass sod is established on the soil-fill over the storage. It has been found that the heat of a single oil lantern, or other small heat source such as an electric light bulb, will provide sufficient heat to prevent freezing during those infrequent periods of extended sub-zero outdoor air temperatures. Even this should not be necessary when the storage is full of vegetables and thus would be lowered in temperature very slowly. It is expected that frost will form on the inside of the steel door during certain periods but this will do no harm to the stored produce. No provision is made for ventilation other than the door which is considered adequate for such a small storage.

Due to an improved corrugation design, the steel sheets have exceptional strength and will support weights and pressures many times in excess of those to which they will ever be subjected, even when used under a barn approach.

Since this storage is constructed of interchangeable sections, it is possible to vary the size of the structure by changing its length. However, the height and width are more or less fixed by the arc of the curved sheets which comprise the roof and side walls. Some usable space is sacrificed with the curved roof and walls, for storage containers are usually cubical in shape and consequently do not stack tightly against the walls. This slight disadvantage of the curved construction is more than offset by the fact that no center supports, nor other reinforcement, is required to hold the earth load in this type of construction.

In the case of the storage pictured here, there was only the minimum of excavation necessary due to the wood ramp which it replaced; therefore, man-hours for excavation were not obtained. These storages could be erected entirely above ground and covered with earth hauled to the location. The least amount of man-hours for earth moving and backfilling would undoubtedly occur where the storage is placed in an earth bank with the front flush with the bank face. If no bank or other raised ground area is available, the storage may be placed in an excavation approximately one-half the volume of the structure, if there is sufficient earth to cover it.

A storage of the dimensions shown in (fig. 1) and pictured in (figs. 2-7) was constructed of 4 sections of channel iron for footer or foundation; 12 curved, corrugated sections for continuous roof and sidewalls; 6 flat, corrugated sections for end walls; 1 2-foot flat, corrugated parapet over the door; and 2 flat, corrugated retaining walls used on the two sides of the doorway or entrance.

Fig. 2.—Plantings flanking the wooden ramp pictured on cover page.

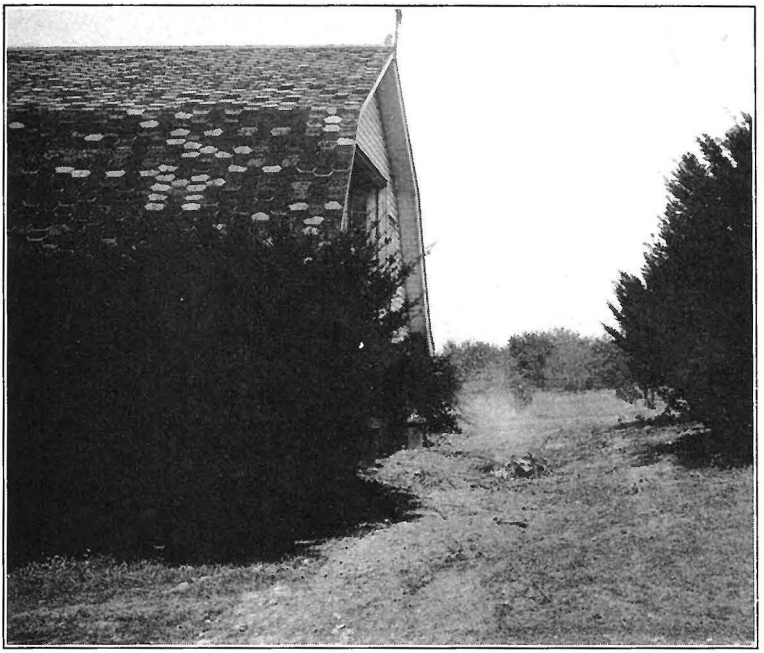


Fig. 3.—At this stage, some plantings have been removed preparatory to excavating for storage structure.

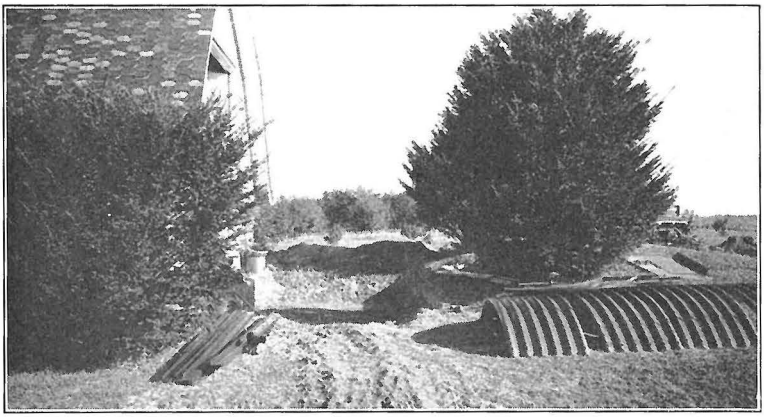


Fig. 4.—Site for storage has been excavated 2 feet below grade line to provide 2-foot clearance above storage for earth-fill ramp.

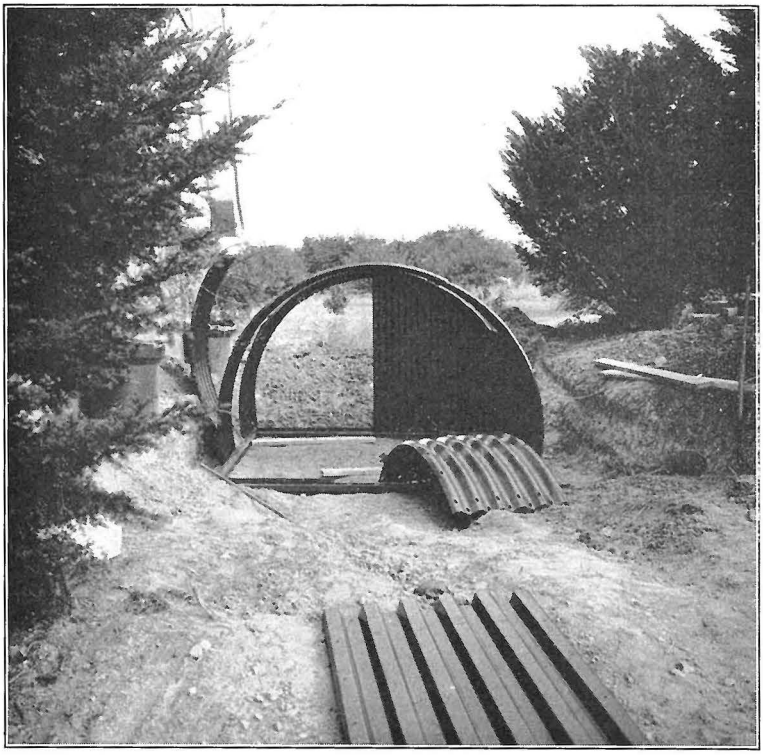


Fig. 5.—All-steel storage under erection. Note channel iron and curved, corrugated sheets. Three sheets comprise one section.

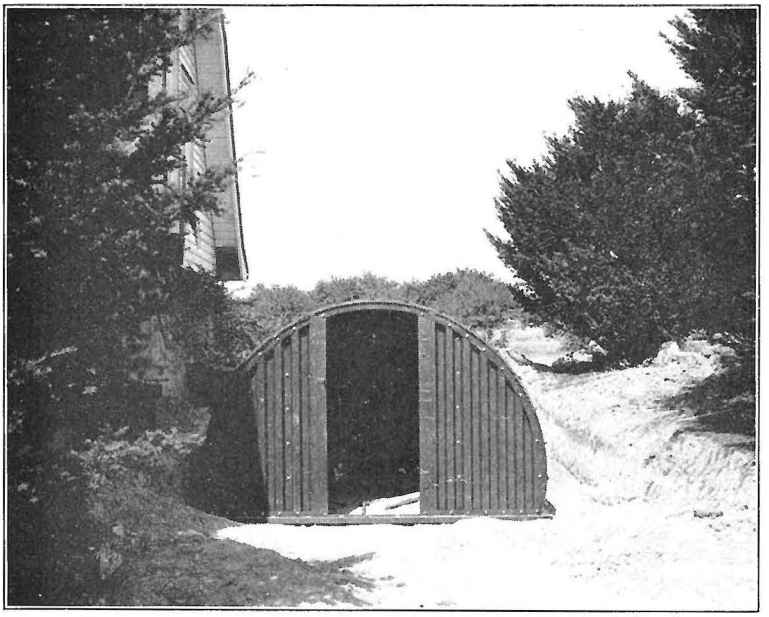


Fig. 6.—Storage ready for door, parapet, and retaining walls.

Fig. 7.—The completed storage is now ready for soil covering. Note slight incurve at base of sides. The roof load is reflected in a side thrust which is neutralized by the well-tamped earth about the storage.

SUMMARY

In the past, many small underground vegetable and fruit storages have been constructed on farms, and, in some cases, in cities, using concrete or block construction for permanency and load bearing properties. Due to the necessity for constructing complicated forms, the labor involved in building an arched roof with supports, and the reinforcing steel necessary in monolithic type construction with flat roofs, the merit of steel for underground construction has been investigated and well proved during the war period. Magazines, huts, and shelters, many placed underground, have been found to be successful. Although the life of such structures underground is not known with certainty, similar metal corrugated culverts are known to have a life in excess of fifteen years. Such all-metal storages, not as yet in mass production, have not been perfected in all respects, nor is it yet possible to more than estimate their probable cost. A storage such as is described in this circular with a floor area of 100 square feet, volume of 490 cubic feet, and a storage space for approximately 200 bushels of produce should cost in the neighborhood of $150 (or 7½ cents per pound), plus freight. Refinements in design and improvements in manufacturing methods should result in lower costs.

The authors, together with a steel fabricating company, have taken this means to point out the possibilities of steel for farm and home storage construction and to picture and describe such a storage placed in use at the Horticultural Department of the Agricultural Experiment Station.